Welcome to ICorr Aberdeen – 2026.

A **Joint Event** with the Energy Institute (Highlands and Islands Branch)

27th January 2026

Integrated Non-Intrusive Instrumentation for Real Time Erosion / Corrosion Monitoring & Management

Presented by : Mike Westwood

Event : Institute of Corrosion - Aberdeen Branch, evening technical presentation
Date : 27 January 2026

Asset Longevity

Proactive Maintenance

Performance Optimisation

Content

1 Principles of Acoustic Sand Detection

2 Principles of Real Time Ultrasonic Wall Thickness Monitoring

3 Maximize value through Integration

4 Case Studies

5 Future Development

Risks of Sand Production

Unplanned downtime

Rising maintenance costs

Risk of containment breach

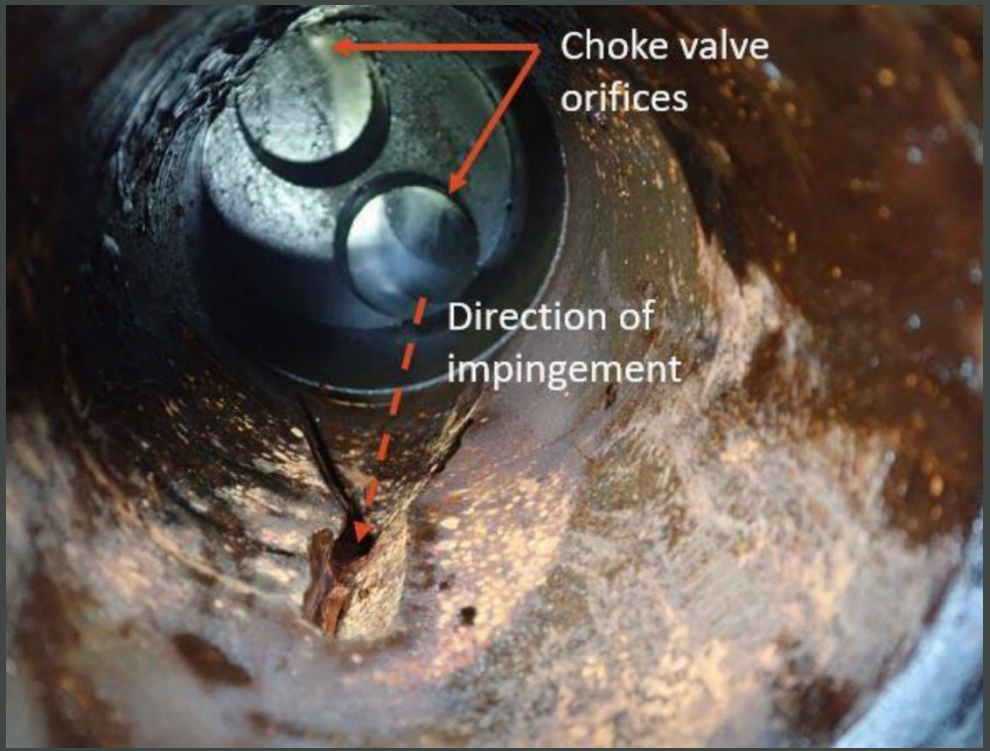
Reduced operational efficiency

Compromises safe, reliable production

While solid production can't always be prevented, real-time monitoring is essential with or without sand control measures. It helps protect equipment, maintain flow assurance, and optimise production throughout the well's lifecycle.

Risks of Sand Production

Ref: Step Change in Safety Alert -2020



Cause:

- Internal Erosion of choke Valve
- Alluding plate choke valve design
- In place for 14 years
- Operating within critical “no go” of 0 -25 % open for short periods
- Historical sand production minimal
- 6 monthly inspection regime had been cancelled due to incorrect understanding that this design of choke had been replaced.

Consequence:

40mm x 3 mm perforation
Uncontrolled release of Hydrocarbons

Poor MOC

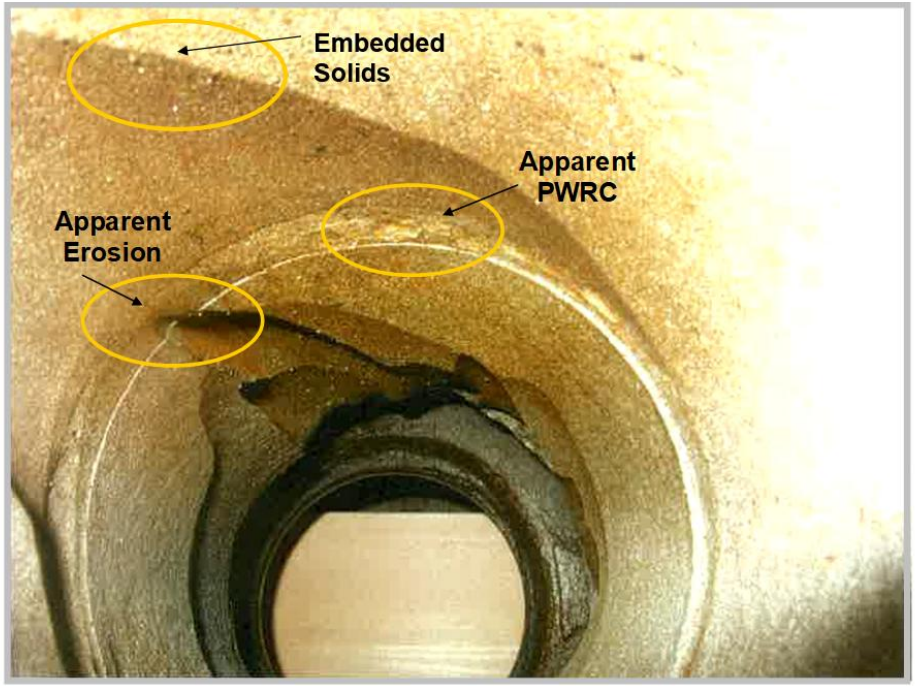
No Sand Monitoring in Place

Risks of Sand Production

Choke Binder leaching, and subsequent erosion.

Risks of Sand Production

Choke Valve



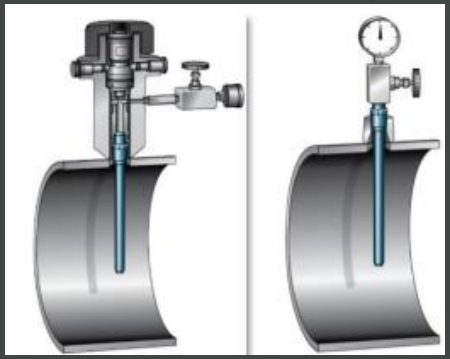
View from Outlet Port, (Behind Seat Pocket)

Traditional Sand Monitoring and Inspection Technologies

Sand Sampling & Weighing

- Qualitative data
  - (particle type, mass estimate)
- Daily / Weekly / Monthly
- Poor repeatability
- No Correlation with process events

Sacrificial Sand probes



- Quantitative data
  - (metal Loss)
- Daily / Weekly
- Poor accuracy
- No Correlation with process events

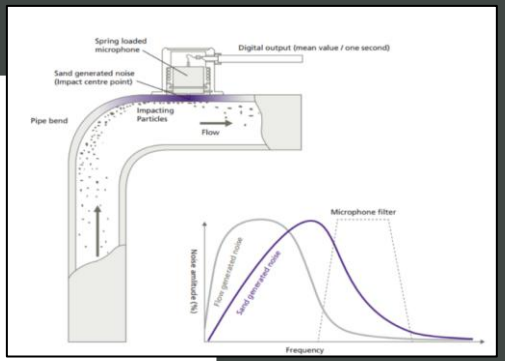
Manual Inspection

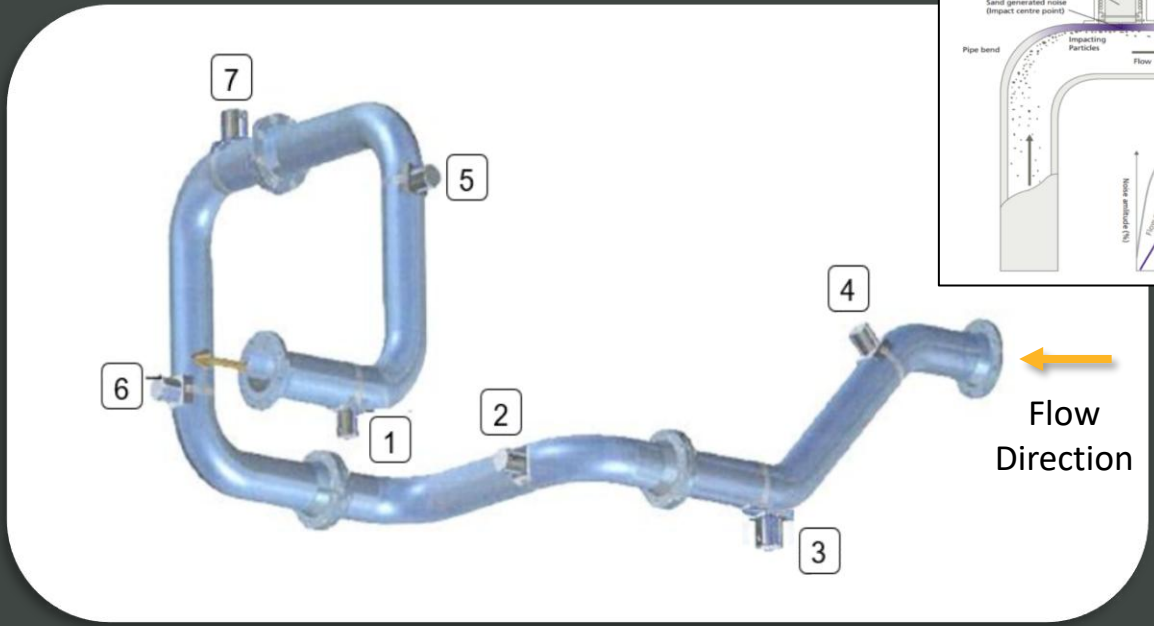
- Qualitative data
  - (Wall Thickness)
- Monthly / 3 Months
- Poor Repeatability
- No Correlation with process events

Acoustic Sand Detectors

- EX-rated instrumentation captures acoustic noise from sand particles impacting flowlines
- Converts signals to electrical energy, visualised as nV vs. time charts for real-time monitoring
- Enables calibrated, quantifiable sand rates via controlled sand injection tests
- Non-Intrusive installation - no process interruptions
- Performance scales with acoustic energy from sand-flowline impacts, ensuring reliable detection

Preferred installation location for sand detectors on pipework

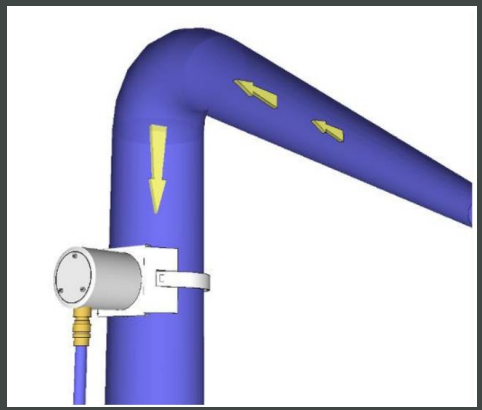




Acoustic Sand Detectors

Specifications

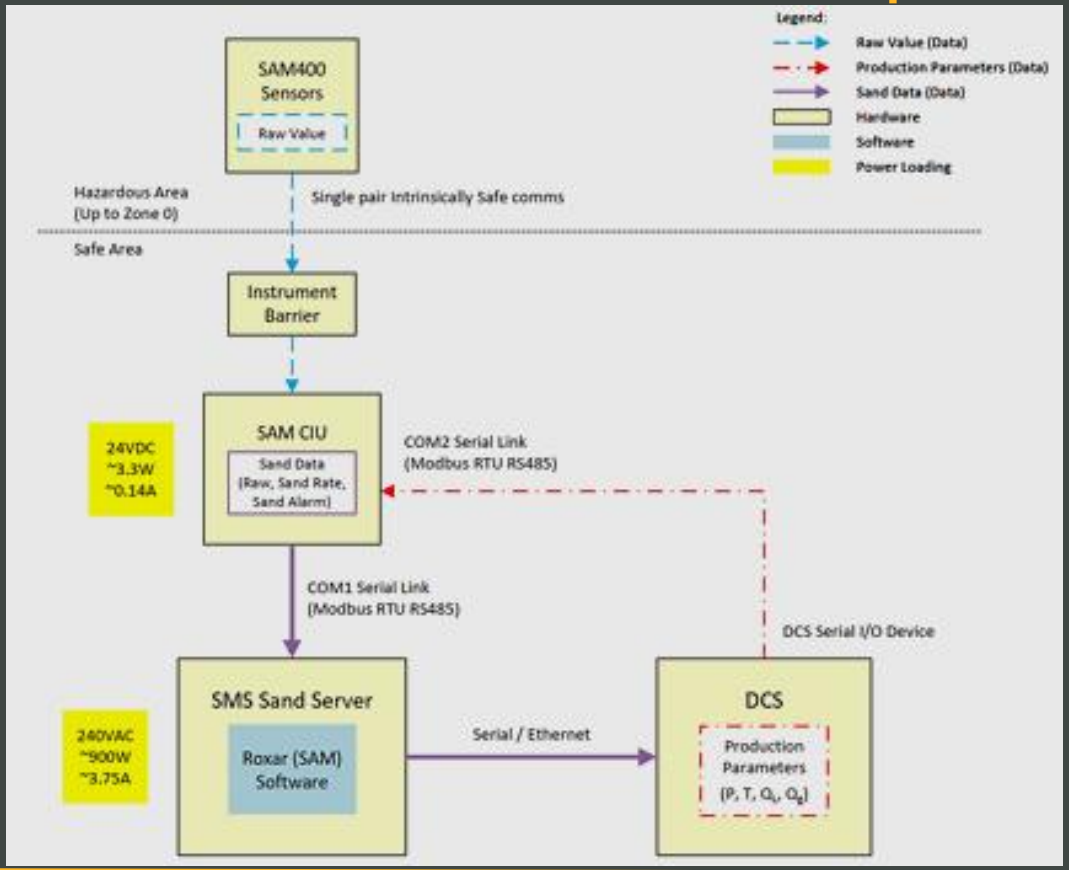
- Particle Detection Limit: 15-25 µm
    - Varies with flow regime, velocity, viscosity
- Output: grams/second (gr/s)
- Pipe Dimension: >2”
- Uncertainty: down to +/- 5% depending on flow regime and calibration level.
- Commonly configured as a sand indicator only
- Flow Velocity: Min 1 m/s for most regimes



Technical Requirements

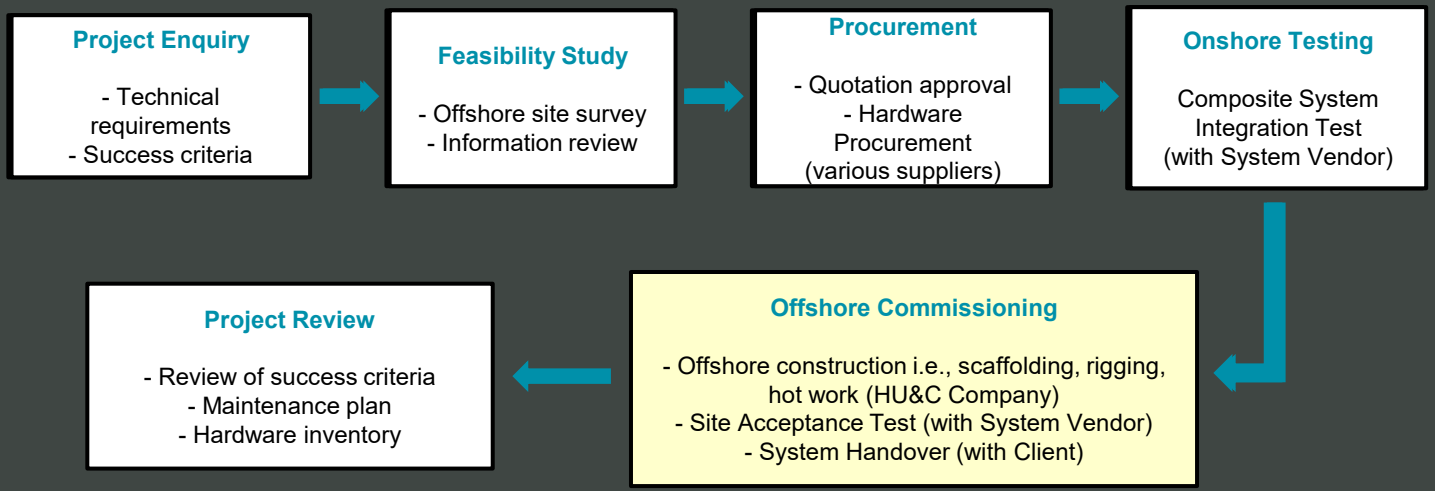
- System configurable for Zone 0 applications
- 24 VDC power supply for detectors
- 240 VAC Power Supply for Sand Server – for configuring sand monitoring system / alarms / calibration
- 2-wire Modbus RS485 connectivity to DCS for hand-off of process parameter data
- Hardware connectivity configurable to serial TCP/IP over various mediums:
    - iEthernet, Radio, Fibre etc

Acoustic Sand Detectors -Technical Requirements



Acoustic Sand Detectors

- **Typical Project Flowchart & Third-Party support**

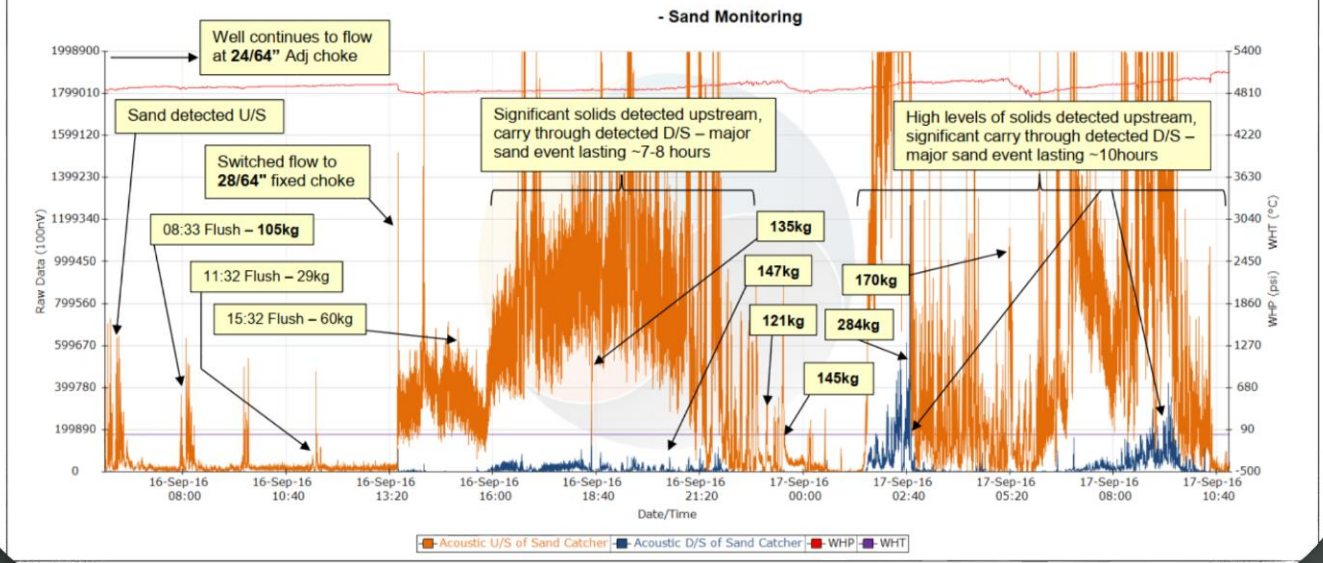


Acoustic Sand Detectors – Data Output

SMS®

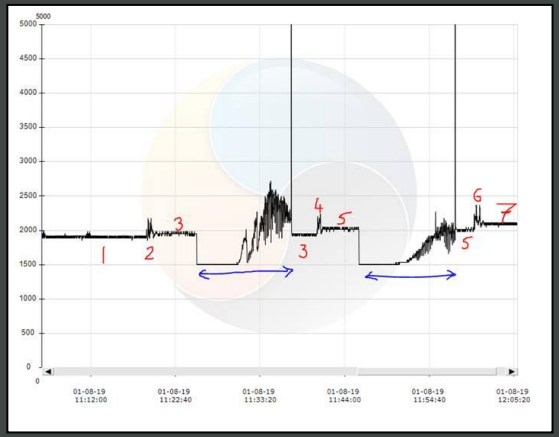
Daily Sand Monitoring Report
F-750.027 Rev 00

Monitoring Chart – Solids Production



Acoustic Sand Detectors - Calibration

- Sand Injection Calibration required for sand quantification (gr/s)
- Re-Calibration required as flow conditions change
- Pump set at specific displacement rate applies a gel containing set concentration of sand at specific displacement rate.



Acoustic Sand Detectors - Testing

- Limitation of Traditional Methods

Separation of testing location and sensor data visualisation lowering confidence of testing methods.

Simple “rule of thumb” approach using non-repeatable methodologies e.g., sandpaper scratch test or wire brush test.

Test results rely on binary pass/fail understanding of data. Lack of proper analysis.

Reading results devoid of any context for transducer performance over time.

Sensitivity Test

Sand Gecko

Transducer Integrity Verification

The Sand Gecko produces targeted signals mimicking the noise of a sand producing well. The output of the transducer under test is then compared with the database of known transducer responses to determine the health status of a given sensor.

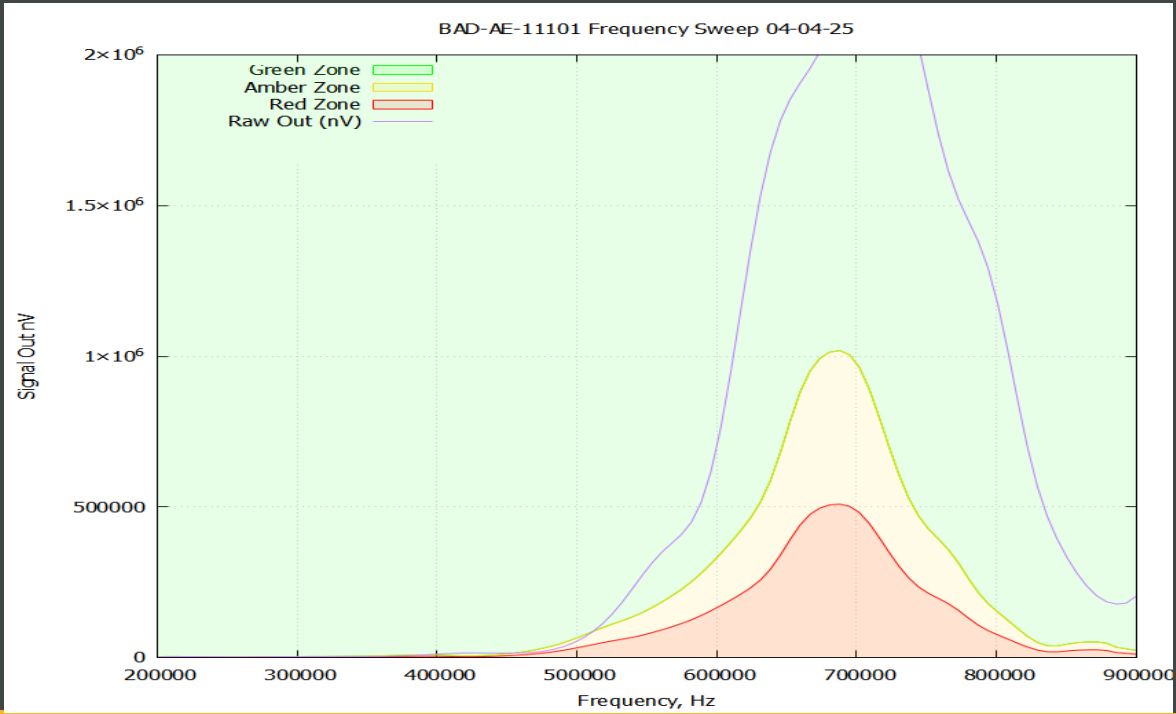
Over time this methodology allows for tracking the integrity of acoustic transducers and identifying those whom have either failed or are showing significant signs of degradation.

Sense. Understand. Perform

Gecko Results

Frequency Sweep Test

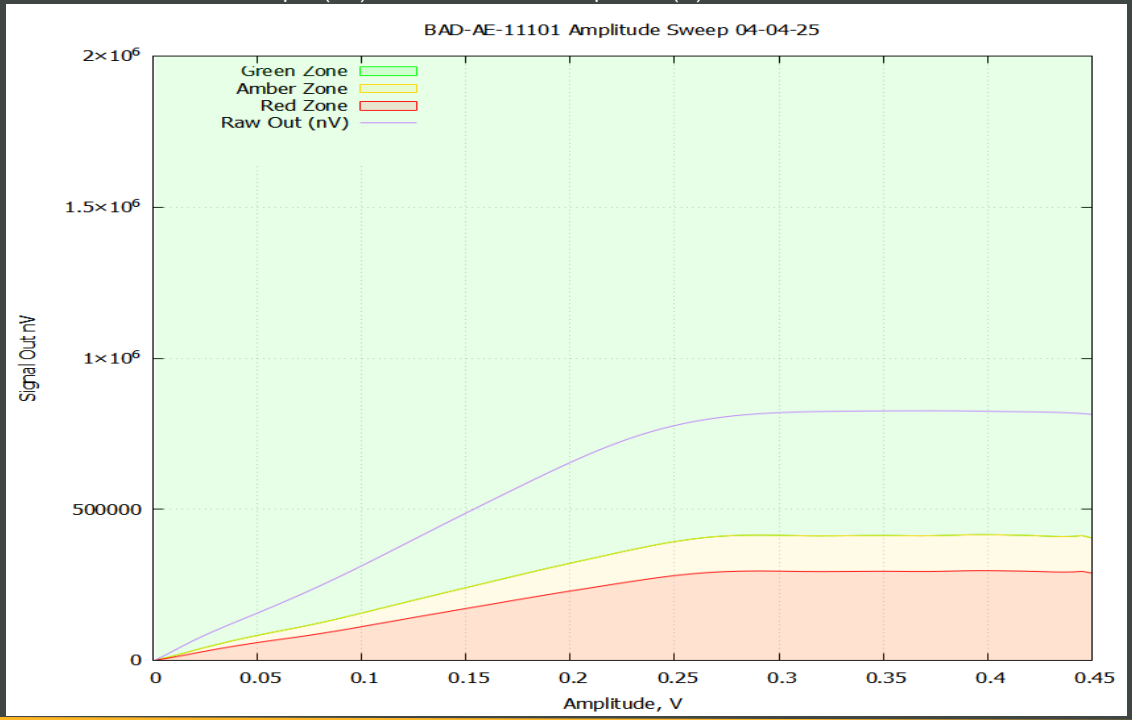
- Applies a swept-frequency signal to the detector, capturing sensor response at every point across the range
- Pinpoints performance degradation anywhere in the frequency spectrum
- Plots sensor electrical output (nV) on Y-axis versus Frequency (Hz) on X-axis



Gecko Results

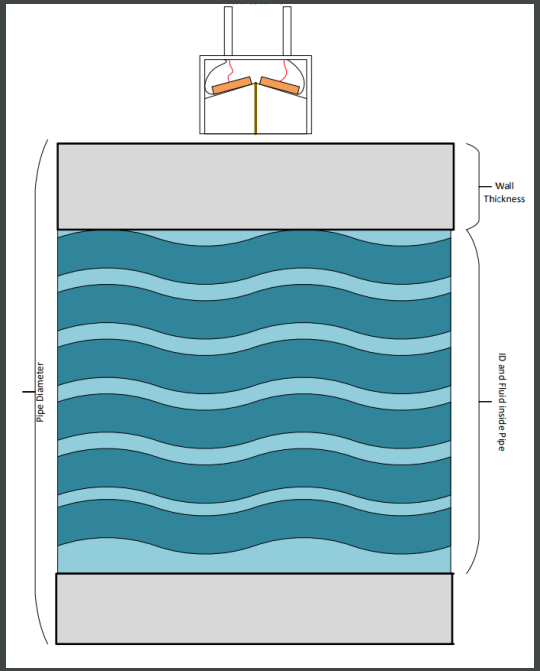
Amplitude Test

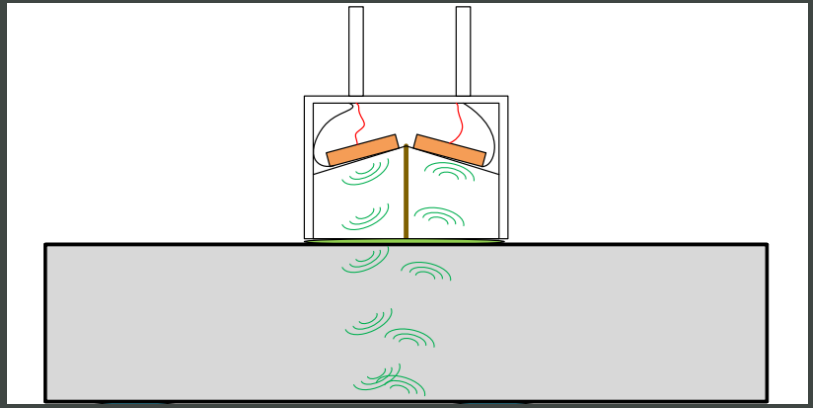
- Varies input signal amplitude at fixed frequency to simulate sand noise levels.
- Delivers clear performance validation against acoustic sand signals.
- Plots sensor electrical output (nV) on Y-axis versus Amplitude (V) on X-axis.



Real Time Ultrasonic (RT-UT)
Wall Thickness Monitoring

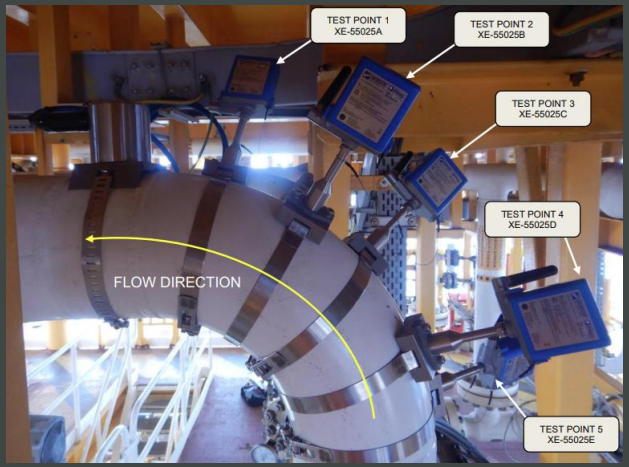
- Traditional Ultrasonic Technology
- Send High frequency sound waves through a material and calculates the thickness based on the time it takes for the echo to return.





Real Time Ultrasonic (RT-UT) Wall Thickness Monitoring

- Non-destructive Ultrasonic testing, permanent or temporary setups
- Calculates remaining wall thickness of flowlines
- Configurable to monitor multiple points (Up to 256 dual-element probes)



- Wired Systems - Suitable for Zone 2 environments
- Wireless systems – Suitable for Zone 1 environments

Real Time Ultrasonic (RT-UT) Wall Thickness Monitoring

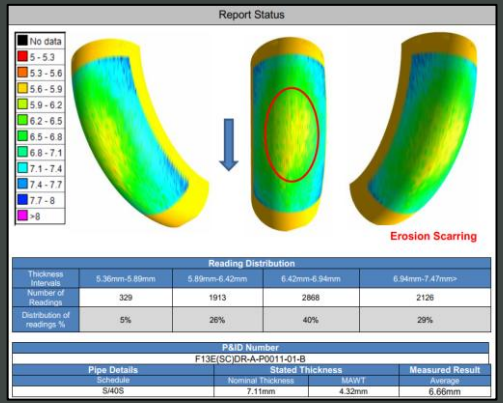
- Dual Probe
- Good for monitoring pitting & areas of heavy ID wall corrosion
- 132ºC Max surface temp
- 1mm – 50mm measurement capability
- Temporary or permanent couplant
- Magnetic [probe holder

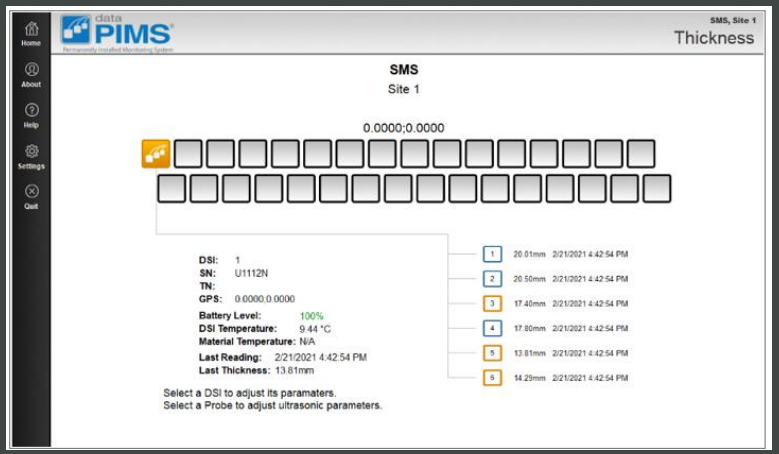
- Ultra-High Temp (UHT) Probe
- Good for erosion / corrosion monitoring
- 500ºC Max surface temp
- 3mm – 25mm measurement capability
- Flexible band for easy installation
    - Pipe OD 3 – 24”
- Stud weld mounting for larger diameter piping / tanks / vessels

Real Time Ultrasonic (RT-UT)

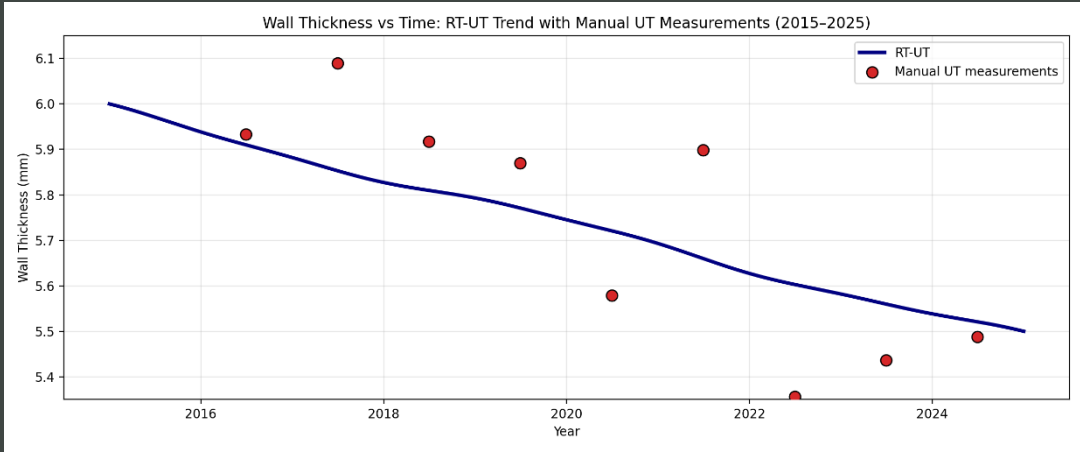
Benefits:

- Non-Intrusive installation – eliminate need to stop production
- Remote operation allows monitoring from safe area
- Real-Time feedback for instantaneous decision making
- Rated for extreme temperatures (-30ºC – 500ºC)
- High precision – 0.025mm
- Integrated sand monitoring package provides comprehensive data
- Local Laptop for short term monitoring
- DCS/SCADA integration for long term monitoring
- High Reputability & Accuracy
- Continuous erosion rate calculation





Real Time Ultrasonic (RT-UT)

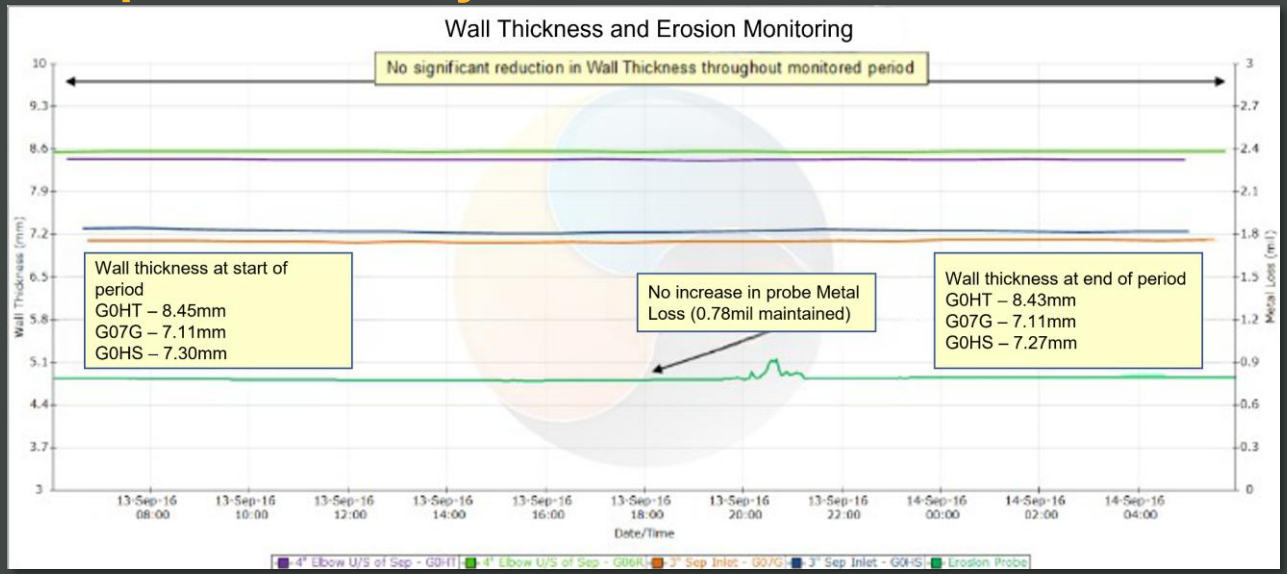


Continuous Measurements / High Repeatability

Continuous Erosion Rate Calculation

Detailed, high frequency data. Insights into asset integrity

Real Time Ultrasonic (RT-UT)
Sample Data Analysis



- Middle East Proppant Flow back operation – high flow rate gas well.
- Proppant production confirmed by ASM Detectors (well would normally be chocked back), Ops continued with approx. 1mm of erosion observed over 24 hours.
- Remote monitoring – removed personnel from red zone

Integration of complimentary instrumentation

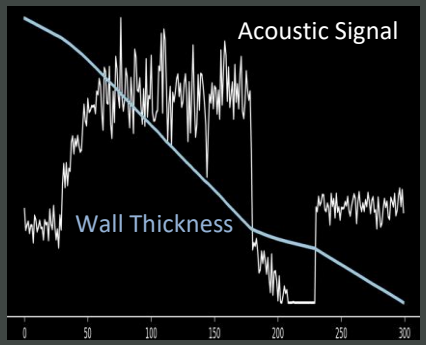
MONITOR RISK

Acoustic Particle Monitor

MONITOR IMPACT

RT-UT Wall Thickness Sensors

Detect Risk PRIOR to damage

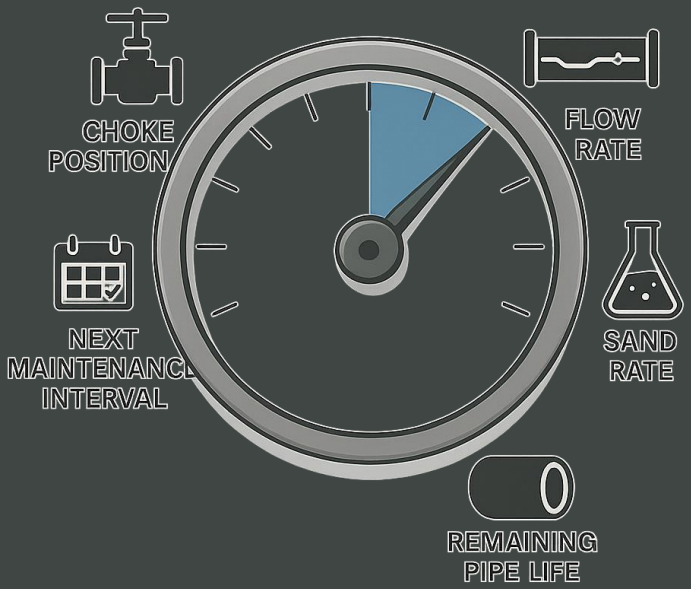


Combined Technologies

- Mitigate Risks from Sand Production
- Extend Operational Life
- Optimize Production Efficiency
- Correlate between sand events and measured erosion rates

Closely Monitor both Cause & Effect

Optimize Production – Minimize Risk



Optimise Production
Determine Max Sand Free Rate (MSFR)
Max Allowable Sand Rate (MASR)

Protect Asset Integrity
Extend pipework life by operating at acceptable sand rate

Prevent Unplanned shutdowns
Reduce damage from erosion, optimise preventative maintenance program

Reduce cost and increase efficiency through use of integrated erosion / corrosion monitoring instrumentation

Case Study: (SE Asia)

Combined Wireless Real-Time UT & Acoustic Sand Monitoring Solution

The Challenge:

- High sand production reported from remote wellhead platform.
- Local monitoring systems were offline or unreliable (Obsolete)
- Threat of Pipeline erosion and potential loss of primary containment (LOPC) at 90° Elbow
- Any new solution must be non-intrusive to as not to interrupt process

Existing monitoring equipment - obsolete

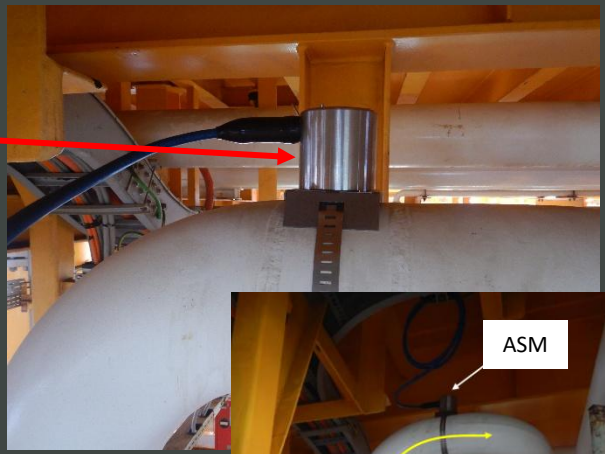
Case Study: (SE Asia)

Combined Wireless Real-Time UT & Acoustic Sand Monitoring Solution

The Solution:

Commission new sand & erosion monitoring system:

- Single Acoustic Detector
- 5 x RT-UT wireless thickness monitoring sensors

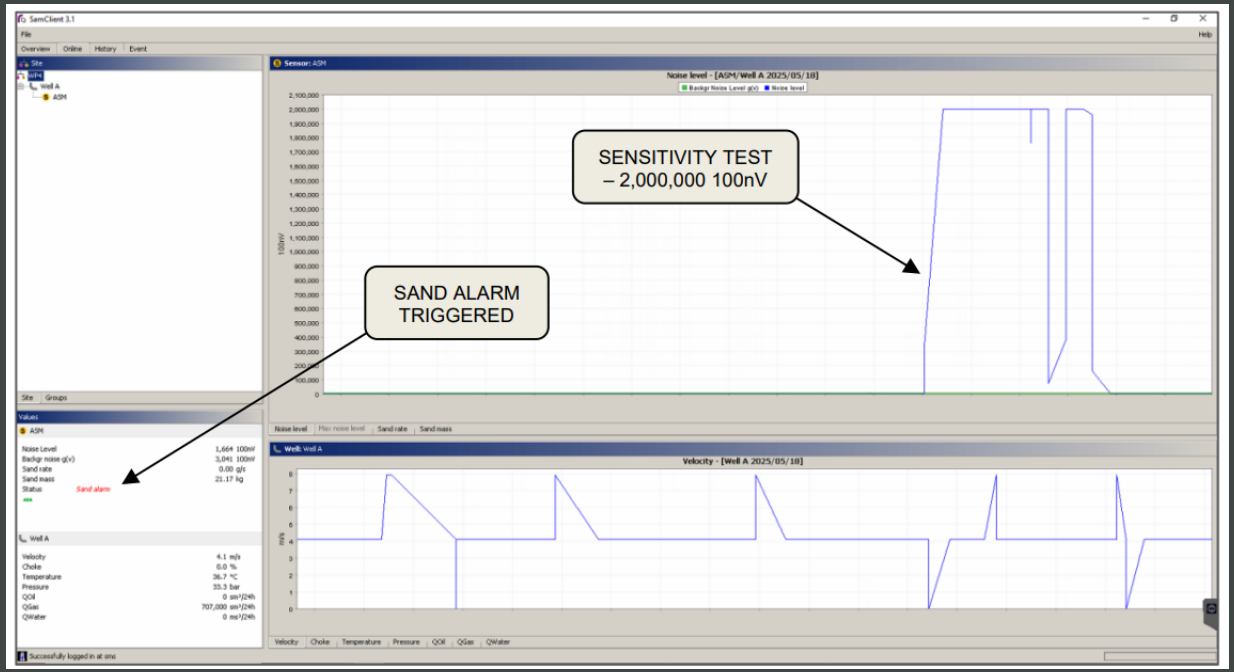


Case Study: (SE Asia)

Combined Wireless Real-Time UT & Acoustic Sand Monitoring Solution

Commisioning:

ASM sensitivity Test:

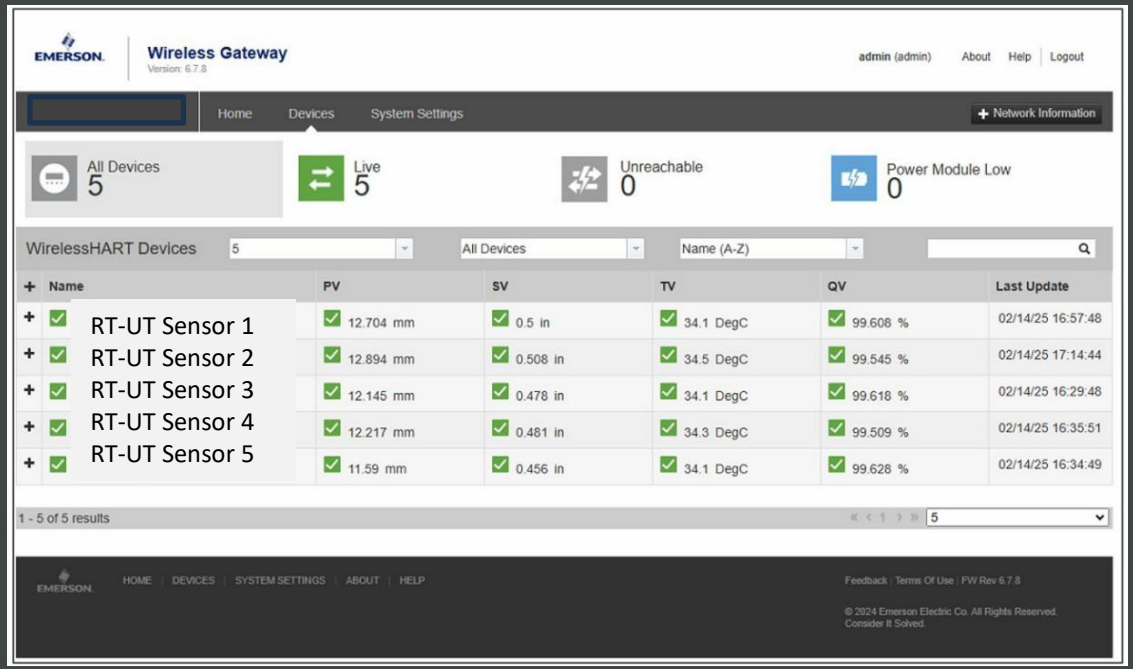


Case Study: (SE Asia)

Combined Wireless Real-Time UT & Acoustic Sand Monitoring Solution

Commisioning:

RT-UT data form all 5 x sensors seen & read from Gateway manager



Case Study: (SE Asia)

Combined Wireless Real-Time UT & Acoustic Sand Monitoring Solution

The Result:

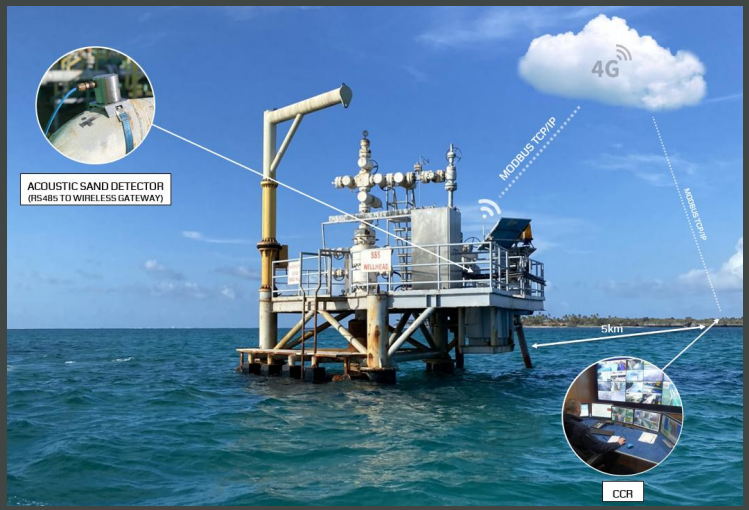
- New system installed and tied into existing local EEx d interface enclosure providing power & com's
- Data integrated into Client DCS
- Full surveillance of well sanding tendencies and resultant impact on pipeline
- Client replicates monitoring system on 4 remaining well on the platform

Case Study 2 : (East Africa)

Bespoke Acoustic Sand Monitoring Solution

The Challenge:

- Geomechanics study conducted in 2020/2021 suggests the imminent onset of sand production
- No Sand Monitoring technology in situ
- Monitoring system must be non-intrusive / clamp type so as not to interrupt the process
- Due to the high chance of deposition, monitoring devices are required upstream / at wellhead location
- No power or communications available at wellhead locations
- Solution must be fully autonomous
- Solution must be modular & mobile for relocation between well sites

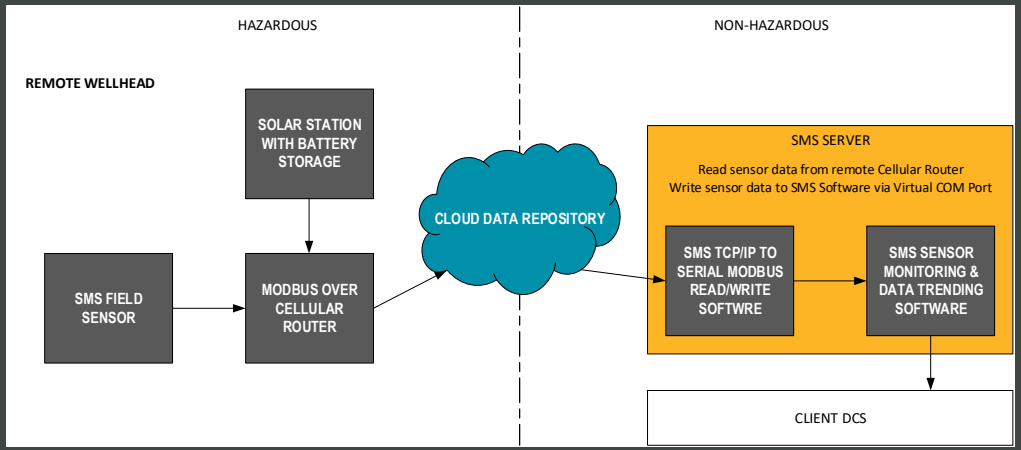


Case Study 2 : (East Africa)

Bespoke Acoustic Sand Monitoring Solution

The Solution:

- Transportable solar station with battery storage capability designed, built, and factory acceptance testing in UK surpasses stress test criteria for three days of autonomy in darkness
- EEx d control panel designed and assembled with integrated sand monitoring and MODBUS over cellular technology
- High gain EEx rated antennas supplied with dual redundancy for uninterrupted data transmission
- In-house software developed to read TCP packets over cellular 4G and hand-off to SMS SMART software via serial MODBUS – tested fully functional
- Sand PC configured with cellular TCP read/write software and SMS SMART software
- SMS SMART software configured to hand-off sand data to client DCS in real-time



Case Study 2 : (East Africa)

Bespoke Acoustic Sand Monitoring Solution

The Result:

- Non-intrusive Acoustic Sand Monitor installed on flowline at remote wellhead (offshore)
- Solar station installed adjacent to Acoustic Sand Monitor and positioned for optimum solar hours
- Sand PC installed in client CCR and connected to DCS module
- Wireless router successfully reads and transmits sand data over 5km to sand PC
- Sand PC successfully reads TCP data over 4G and hands-off to SMS SMART
- Sand PC successfully integrated with client DCS
- System fully commissioned and site acceptance tested within the allocated timeframe
- Training and handover to site reps with the provision of health checklists, SOPs, and software familiarisation
- Sand data for remote wells trending and logging both at Sand PC CPU and client DCS
- Client provided with full coverage and visibility of well sanding tendencies, clean-up duration, critical drawdown, and Maximum Sand Free Rates (MSFR)

Value to Client:

- Remote Location Monitoring: Early identification of sanding events from remote wells
- Real-time: Immediate data availability, for dynamic and informed decision making
- Reduced Cost: Minimal personnel and maintenance required
- Repeatable and Reliable: Reliable method of tracking sand production

Case Study 2 : (East Africa)

Bespoke Acoustic Sand Monitoring Solution

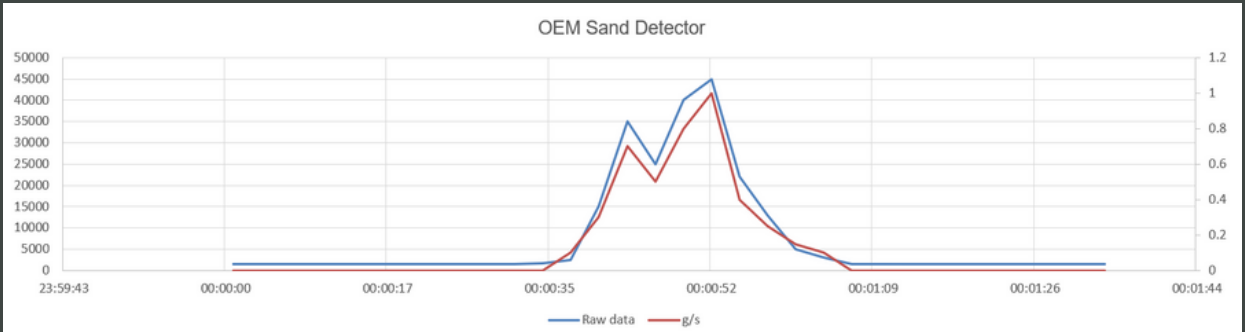
Solids Monitoring Development : Next Evolution of Integrity Monitoring

Call for Action – what instrumentation / data is needed?

Limitations of Existing Sand Detectors

- Raw data often includes sand spikes along with significant background noise
- Volume readings can be accurate, but only with careful calibration
- Calibration must be repeated for different flow conditions. Any change in flow can result in inaccurate measurements

Sensor design has remained unchanged for over four decades, with minimal innovation or adaptation to current operational needs



What Matters in Solid Monitoring

Key Solid Characteristics & Their Operational Impact

CHARACTERISTIC	WHY IT MATTERS	OPERATIONAL APPLICATIONS
Size	Different sizes affect sand control strategies and erosion potential	- Sand screen selection - Sand Screen Failure - Predictive maintenance planning - Formation integrity assessment
Type	Identifying whether the solids are sand, proppant, debris, or scale guides response	- Frack support - Scale management / Chemicals - Debris mitigation
Velocity	Higher velocity increases the risk of impact damage and erosion	- Erosion rate calculations - Equipment damage estimation
Impact Location	Knowing where solids are hitting allows for targeted monitoring and mitigation	- Damage modelling - Optimising placement of wall thickness sensors

Future Solids Detection

Single instrumentation package to deliver a complete profile of solids behavior, accurately, reliably, and without manual calibration.
Seemless interface for Autonomous decision making

Advanced Solid Characterisation

- Detect and differentiate:
  a. Volume
  b. Size (for sand control and screen design)
  c. Type / Shape (e.g., proppant, sand, scale, debris)
  d. Velocity (for erosion modelling and damage prediction)
  e. Impact Location (to guide monitoring point placement)

Self-Calibrating System

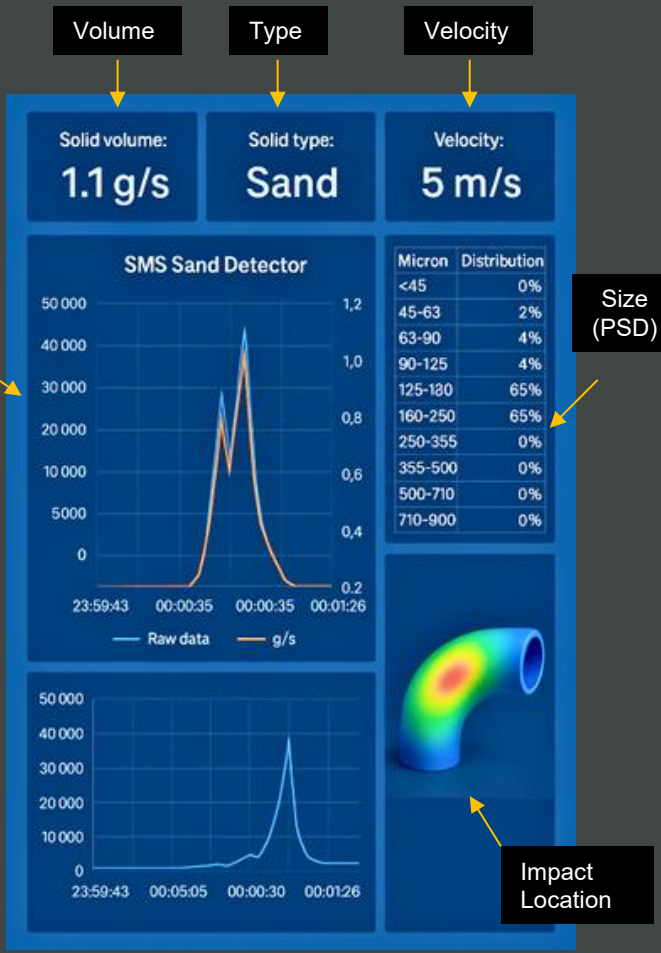
- Automatically removes background noise. No need for repeated manual tuning.

Scalable Multi-Sensor Setup

- Support multiple Ultrasonic and Acoustic transducers for wide coverage and redundancy.

Flexible Deployment

- Available in battery-operated, wireless, or wired configurations for use in remote or topside applications.



Sense. Understand. Perform

Let's Keep in Touch

Contact

Mike Westwood
m.westwood@smsintegrity.com

www.smsintegrity.com

UK Head Office

Sand Monitoring Services Ltd
Energy Development Centre
Aberdeen Science & Energy Park
Claymore Drive
Bridge of Don
Aberdeen, Scotland
AB23 8GD

Tel: +44 (0) 1224 853 525
Email: info@smsintegrity.com

Malaysia Office

SMS Sand Management Services Sdn Bhd
26th Floor, Menara Maxis
Kuala Lumpur City Centre
50088 Kuala Lumpur
Malaysia

Tel: +60 (0) 3 2615 2606
Email: info@smsintegrity.com

Advancing Corrosion Science & Engineering

Institute of Corrosion
Corrosion House, 5 St Peters Gardens, Marefair, Northampton, NN1 1SX
www.icorr.org

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